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Original Contribution

Psychiatric Diagnoses in Historic and Contemporary Military Cohorts: Combat Deployment and the Healthy Warrior Effect

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Research studies have identified heightened psychiatric problems among veterans of Operation Iraqi Freedom (OIF) and Operation Enduring Freedom (OEF). However, these studies have not compared incidence rates of psychiatric disorders across robust cohorts, nor have they documented psychiatric problems prior to combat exposure. The authors' objectives in this study were to determine incidence rates of diagnosed mental disorders in a cohort of Marines deployed to combat during OIF or OEF in 2001–2005 and to compare these with mental disorder rates in two historical and two contemporary military control groups. After exclusion of persons who had been deployed to a combat zone with a preexisting psychiatric diagnosis, the cumulative rate of post-OIF/-OEF mental disorders was 6.4%. All psychiatric conditions except post-traumatic stress disorder occurred at a lower rate in combat-deployed personnel than in personnel who were not deployed to a combat zone. The findings suggest that psychiatric disorders in Marines are diagnosed most frequently during the initial months of recruit training rather than after combat deployment. The disproportionate loss of psychologically unfit personnel early in training creates a "healthy warrior effect," because only those persons who have proven their resilience during training remain eligible for combat.

cohort studies; incidence; mental disorders; military personnel

Abbreviations: ICD-9-CM, *International Classification of Diseases, Ninth Revision, Clinical Modification*; OEF, Operation Enduring Freedom; OIF, Operation Iraqi Freedom; PTSD, post-traumatic stress disorder.

Editor's note: An invited commentary on this article appears on page 1277.

Growing concern about the psychological costs of current American military operations (particularly Operation Iraqi Freedom (OIF) and Operation Enduring Freedom (OEF)) compels our nation to estimate and prepare for the level of assistance that will probably be needed by those returning from war. History is an inexact guide on this matter, because each war differs in duration, intensity, and credibility of purpose, and each war brings new controversies about psychological morbidity. For example, research findings on the

mental health of Vietnam War veterans have been inconsistent. While the National Vietnam Veterans' Readjustment Study was viewed as definitive for many years, newer analyses indicate that its mental disorder estimates were excessive (1, 2). Initial results showed that 30.9 percent of Vietnam veterans developed post-traumatic stress disorder (PTSD) during their lifetimes, whereas Dohrenwend et al. (2) recently published a PTSD lifetime prevalence estimate of 18.7 percent after reexamining available evidence.

Operation Desert Storm (Persian Gulf War, 1991) produced, by most estimates, lower rates of PTSD than did the Vietnam War (3, 4). An analysis of a Department of Veterans Affairs cohort found that 10 percent of personnel

deployed to Operation Desert Storm, as compared with 4 percent of controls, met symptom-based criteria for PTSD (5). However, the physical and mental health of Desert Storm veterans continues to be the subject of active research and debate (5–8), and it is by no means certain that the psychiatric burden of the Persian Gulf War is fully understood.

Initial surveys of service personnel returning from OIF indicated that 15.6 percent of US Marine Corps personnel and 17.1 percent of US Army personnel had experienced symptoms associated with PTSD (9). Subsequent studies utilizing diverse sources of data have reported that 7–10 percent of OIF veterans meet PTSD screening criteria for clinical referral (10–12). In addition to heightened rates of PTSD symptoms, OIF/OEF combatants have also reported symptoms of heightened depression, anxiety, and other mental health conditions (13).

Recent analyses of psychiatric problems in OIF/OEF veterans have fallen short on several counts. Specifically, preexisting mental disorders (prior to deployment) have not been fully considered, and noncombatant control groups have rarely been used as comparison populations. Additionally, studies have relied on self-report screening tools and have not taken into account actual mental health diagnoses. For these reasons, we conducted a prospective study with data on both pre- and postdeployment use of psychiatric health-care services by OIF and OEF veterans and examined the incidence of diagnosed mental health conditions across multiple populations.

Our objectives in this study were to 1) determine incidence rates of diagnosed mental disorders in Marines deployed to combat during OIF or OEF and 2) compare this mental-disorder incidence rate with rates in historical and contemporary military control groups.

MATERIALS AND METHODS

Study population

The subjects for this population-based analysis included active-duty US Navy and Marine Corps personnel from five contemporary and historical cohorts. Reservists were not included in the study. The primary group of interest consisted of all 41,561 contemporary Marines who enlisted between July 2001 and September 2004 and were deployed to an OIF or OEF combat zone prior to September 2005. Other contemporary cohorts included all 59,595 Marines and all 94,365 Navy personnel who enlisted between July 2001 and September 2004 and were not deployed to a combat zone during an observation period ending in September 2005. For all three contemporary cohorts, *all* psychiatric diagnoses (including all inpatient and outpatient psychiatric diagnoses from both military clinics and civilian clinics in the TRICARE network) were recorded up to September 2005.

The two historical cohorts consisted of 1) all enlisted Navy personnel ($n = 156,474$) and 2) all enlisted Marines ($n = 109,059$) who joined the military between July 1997 and September 2000. Only hospitalization data were available for these cohorts, and all psychiatric hospitalizations were recorded for these two cohorts from enlistment until September 2001.

Although the focus of this research was on Marines, contemporary and historical Navy data were included to help

clarify any broader military population trends emerging across time, irrespective of combat exposure. Members of each cohort were observed for at least 1 year or until separation from the military. The institutional review board of the Naval Health Research Center approved the protocol for this study.

Data collection

Deployment records. Deployment information was obtained from the Defense Manpower Data Center (Monterey, California). Combat deployment was defined as receiving a combat-zone tax exclusion or hazardous duty/imminent danger pay and being deployed to Iraq, Kuwait, or Qatar (OIF) or Afghanistan (OEF) during the study period. Personnel who received hazardous duty pay but were not deployed to Iraq, Kuwait, Qatar, or Afghanistan were excluded from the Marine Corps combat deployment cohort. In this sample, a total of 41,561 Marines were combat-deployed. Of these, 38,187 Marines were deployed only in OIF, 2,992 Marines were deployed only in OEF, and 382 Marines were deployed in both OIF and OEF. Because only 7 percent of the deployed sample was composed of OEF deployers, we do not discuss them separately in this paper. Combat-deployed Navy personnel were excluded from the contemporary Navy sample.

Personnel data files. Personnel data are routinely accessed through the Defense Enrollment Eligibility Reporting System (Monterey, California) and the Defense Manpower Data Center. Information gathered from these sources included Armed Forces Qualification Test cognitive ability scores, demographic information, duty station, separation cause codes (if applicable), and length of service. Data on some of these variables were redundant with other study data but were gathered for cross-checking and quality control.

Inpatient and outpatient data records. Inpatient and outpatient psychiatric diagnoses from credentialed providers at military treatment facilities and government-reimbursed private clinics were obtained from Standard Inpatient Data Record, Standard Ambulatory Data Record, and Health Care Service Record files via TRICARE Management Activity (a Department of Defense agency that administers TRICARE, the health-care program for military personnel). These records are generated for military personnel at every inpatient and outpatient medical encounter and include the applicable known or presumed medical diagnoses, coded using the *International Classification of Diseases, Ninth Revision, Clinical Modification* (ICD-9-CM). Participants were defined as having a psychiatric diagnosis if their Standard Inpatient Data Record, Standard Ambulatory Data Record, or Health Care Service Record file included an ICD-9-CM diagnosis code within the range of 290–316 (mental disorders) (table 1). All diagnostic data were postenlistment.

Service members who were diagnosed with more than one mental disorder during the study period were counted in every diagnostic category in which they were represented. For example, persons diagnosed with both an alcohol-use disorder (ICD-9-CM code 291) and a panic disorder (ICD-9-CM code 300.01) were included in both the substance-related disorder and anxiety disorder categories. Persons

TABLE 1. International Classification of Diseases, Ninth Revision, Clinical Modification, codes* corresponding to mental disorders analyzed in a study of US Navy and Marine Corps personnel deployed during Operation Iraqi Freedom and Operation Enduring Freedom, 2001–2005

Diagnostic category	International Classification of Diseases, Ninth Revision, Clinical Modification, code
All mental disorders	290–316
Substance-related disorders	291, 292 (except 292.2), 303, 304, 305.0, 305.2–305.7, and 305.9
Adjustment disorders	309.0, 309.24, 309.28, 309.3, 309.4, and 309.9
Mood disorders	296.0, 296.2, 296.3, 296.4–296.7, 296.80, 296.89, 296.90, 300.4, 301.13, and 311
Personality disorders	301.0, 301.2, 301.4, 301.50, 301.6, 301.7, 301.81–301.84, 301.89, and 301.9
Psychotic disorders	295.1–295.3, 295.4, 295.6, 295.7, 295.9, 297.1, 297.3, 298.8, and 298.9
Anxiety disorders	
Panic disorder	300.01 and 300.21
Generalized anxiety disorder	300.02
Obsessive-compulsive disorder	300.3
Phobia	300.22, 300.23, and 300.29
Acute stress disorder	308.3
Post-traumatic stress disorder	309.81
Anxiety, not otherwise specified	300.00
Somatoform/dissociative/factitious disorders	300.11–300.16, 300.19, 300.6, 300.7, 300.81, 307.80, and 307.89
Other mental disorders	All 290–316 codes not listed above

* Unless otherwise specified, all three- and four-digit codes include all subcodes.

diagnosed with both an alcohol-use disorder and a drug-use disorder (ICD-9-CM code 292) were counted only one time in the substance-related disorder category (ICD-9-CM code 291). Persons diagnosed with more than one subtype of anxiety disorder were counted in each subtype group and once in the anxiety disorder category.

Statistical analyses

Descriptive statistics, including percentages for categorical data and mean values and standard deviations for continuous data, were generated and stratified by cohort. Proportions were compared using the chi-squared test, and ratios were compared using the *t* test. Crude relative risks were estimated in comparison with the reference category of Marine Corps personnel who were not deployed to a combat zone. Relative risks adjusted for sex and race were estimated

using the Mantel-Haenszel confounder-adjusted odds ratio (14). Statistical analyses were performed using SPSS software, version 15.0 (SPSS, Inc., Chicago, Illinois).

Incidence densities per 1,000 personnel were calculated by dividing the number of new psychiatric diagnoses during each study month by the sum of person-months at risk. Personnel contributed person-months to the denominator until they received a psychiatric diagnosis (after which they were no longer at risk) or until they were no longer part of the military (terminating our access to their medical records).

RESULTS

Table 2 compares the demographic characteristics and psychiatric hospitalization rates of the three contemporary cohorts (Navy personnel with no combat deployment, Marines with no combat deployment, and combat-deployed Marines) with those of the historical Navy and Marine Corps reference cohorts. The demographic analyses revealed that nearly all of the variables evaluated showed significant differences from the reference cohorts ($p < 0.05$). The Marine Corps had a higher percentage of White service members than did the Navy. The Marine Corps traditionally has had a higher percentage of males than the Navy; accordingly, the contemporary combat-deployed Marine group had a higher percentage of males (96.7 percent) than any other cohort.

The rate of early separation (i.e., failure to complete the contracted term of enlistment) in combat-deployed Marines was markedly lower than in any other cohort. This result is partly tautological (like saying there are more survivors in the surviving group), since Marines who separate from service early tend to do so before they are eligible to deploy (e.g., during their initial training).

Psychiatric hospitalizations

The Navy hospitalization rate for psychiatric diagnoses exceeded the Marine Corps rate during both time periods (table 2). There were slight increases in rates of psychiatric hospitalization among newly enlisted Navy personnel from 1997 to 2001 and from 2001 to 2005, suggesting that mental health was moderately stable over this time period for personnel not exposed to war. Moreover, the aggregated hospitalization percentage for mental disorders in the combined non-combat-deployed and combat-deployed contemporary Marine cohorts (2.3 percent; data not shown) was approximately equal to the hospitalization rate for the historical Marine cohort (2.4 percent), despite the greater combat exposure in almost half of the contemporary group.

With the exception of the combat-deployed Marines, 21.9–32.8 percent of subjects hospitalized with a psychiatric diagnosis (across cohorts) had their initial diagnosis recorded within the first 6 months of military service (table 2). Among those diagnosed in the combat-deployed Marine sample, only 4.7 percent were diagnosed within the first 6 months. In addition, deployed Marines had been in the service for a longer period of time before being diagnosed. Overall, their mean time to diagnosis was 22.4 months, while the other four cohorts had mean times ranging from 12.3 months to 14.2 months.

TABLE 2. Demographic characteristics and psychiatric hospitalization rates of two historical reference cohorts (1997–2001) and three contemporary cohorts (2001–2005) of US Navy and Marine Corps personnel

Characteristic	Historical reference cohorts (1997–2001)		Contemporary cohorts (2001–2005)		
	Navy† (<i>n</i> = 156,474)	Marines‡ (<i>n</i> = 109,059)	Navy, non- combat-deployed (<i>n</i> = 94,365)	Marines, non- combat-deployed (<i>n</i> = 59,595)	Marines, combat-deployed (<i>n</i> = 41,561)
Mean age of accession (years)§	20.1 (2.7)¶	19.6 (2.0)	20.4* (2.9)	19.7* (2.1)	19.5 (2.0)
Sex (%)#					
Male	82.0	92.9	81.9	90.3*	96.7*
Female	18.0	7.1	18.1	9.7*	3.3*
Race/ethnicity#					
White	58.3	68.0	64.1*	71.9*	69.6*
Black	19.9	13.0	18.2*	9.2*	8.0*
Asian	4.7	2.0	3.7*	2.2*	2.3*
Hispanic	12.0	14.2	5.4*	11.9*	15.9*
Other/mixed	4.9	2.8	7.5*	2.4*	2.6*
Missing data	0.1	0.0	1.1*	2.4*	1.6*
Mean Armed Forces Qualification Test score§	59.0 (18.6)	58.4 (17.9)	61.7* (18.8)	61.2* (18.0)	58.5 (18.1)
Separation status#					
Early separation	23.0	22.1	25.3*	30.9*	3.6*
Still on active duty	69.5	71.5	68.0*	64.6*	88.6*
Normal separation	7.5	6.4	6.7*	4.5*	7.8*
Hospitalization for psychiatric disorder (%)#	3.5	2.4	3.7*	3.0*	1.6*
% of psychiatric hospitalizations occurring within first 6 months of service#	32.1	21.9	32.8*	26.1*	4.7*
Mean length of service (months) at first psychiatric hospitalization§	12.3 (10.2)	14.2 (10.4)	12.6* (10.5)	12.3* (9.0)	22.4* (10.9)

* $p < 0.05$ (statistically different from reference group).

† The historical Navy cohort was the reference group for the concurrent Navy cohort.

‡ The historical Marine cohort was the reference group for the concurrent non-combat-deployed Marine cohort and the concurrent combat-deployed Marine cohort.

§ A *t* test was performed.

¶ Numbers in parentheses, standard deviation.

A χ^2 test was performed.

All psychiatric encounters

Table 3 shows psychiatric incidence rates for three categories of Marine Corps personnel: non-combat-deployed personnel, all combat-deployed personnel, and combat-deployed personnel with no precombat psychiatric diagnoses. Broad diagnostic categories are displayed, along with specific subtypes of anxiety disorders to illustrate trends in PTSD. Combat-deployed Marines had a much lower rate of diagnosed psychiatric disorders (11.8 percent) than Marines not deployed to combat (21.1 percent) (table 3). (The rate of psychiatric diagnoses from inpatient and outpatient records (combined) for Navy personnel who enlisted between 2001 and 2004 was 27.8 percent (data not shown).) The only diagnostic categories in which combat-deployed Marines had significantly higher rates than non-combat-deployed Marines were acute stress disorder (0.4 percent vs. 0.3 percent) and PTSD (1.6 percent vs. 0.6 percent) ($p < 0.05$). Of the 4,899 combat-deployed Marines diagnosed with a psy-

chiatric disorder, almost half ($n = 2,395$) went to war with a preexisting psychiatric diagnosis.

Once Marines with preexisting diagnosed disorders were excluded, the cumulative rate of postcombat mental disorders was 6.4 percent, and PTSD became the only condition with a higher rate in deployed personnel than in non-combat-deployed personnel (1.5 percent vs. 0.6 percent) (table 3). After adjustment for race and sex, combat-deployed Marines were more than three times as likely to be diagnosed with PTSD as non-combat-deployed Marines (adjusted relative risk = 3.27). In the non-combat-deployed cohort, 0.4 percent were diagnosed with other psychiatric conditions in addition to PTSD (data not shown). In the combat-deployed cohorts, 1.3 percent in the total combat-deployed cohort and 1.1 percent in the combat-deployed subset with no predeployment diagnoses had psychiatric conditions in addition to PTSD. Among persons with PTSD and more than one psychiatric diagnosis, PTSD was listed as the first psychiatric diagnosis in 23.8 percent of the non-combat-deployed cohort,

TABLE 3. Incidence rates and relative risks for all psychiatric diagnoses (inpatient and outpatient) in contemporary non-combat-deployed Marines and combat-deployed Marines, 2001–2005

Diagnostic category†	Non-combat-deployed Marines‡ (n = 59,595)		Combat-deployed Marines (all personnel) (n = 41,561)						Combat-deployed Marines (excluding personnel diagnosed precombat) (n = 39,166)					
	No.	%	No.	%	Crude RR§	95% CI§	Adjusted RR¶	95% CI	No.	%	Crude RR	95% CI	Adjusted RR¶	95% CI
All mental disorders	12,585	21.1	4,899	11.8	0.56*	0.54, 0.58	0.54*	0.52, 0.57	2,504	6.4	0.30*	0.29, 0.32	0.27*	0.26, 0.29
Substance-related disorders	2,778	4.7	1,973	4.7	1.02	0.96, 1.08	1.01	0.95, 1.07	958	2.4	0.53*	0.48, 0.56	0.51*	0.47, 0.55
Adjustment disorders	4,277	7.2	995	2.4	0.33*	0.31, 0.36	0.34*	0.32, 0.37	468	1.2	0.17*	0.15, 0.18	0.17*	0.15, 0.19
Mood disorders	3,711	6.2	1,069	2.6	0.41*	0.39, 0.44	0.45*	0.42, 0.48	606	1.5	0.25*	0.23, 0.27	0.27*	0.24, 0.30
Personality disorders	2,510	4.2	460	1.1	0.26*	0.24, 0.29	0.27*	0.25, 0.30	255	0.7	0.16*	0.14, 0.18	0.16*	0.13, 0.18
Psychotic disorders	229	0.4	43	0.1	0.27*	0.29, 0.37	0.26*	0.19, 0.37	34	0.1	0.23*	0.15, 0.32	0.22*	0.15, 0.30
Anxiety disorders	2,041	3.4	1,158	2.8	0.81*	0.76, 0.87	0.93	0.86, 1.00	811	2.1	0.61*	0.56, 0.66	0.69*	0.63, 0.75
Panic disorder	321	0.5	98	0.2	0.44*	0.35, 0.55	0.50*	0.40, 0.63	60	0.2	0.28*	0.22, 0.38	0.32*	0.25, 0.43
Generalized anxiety disorder	322	0.5	136	0.3	0.61*	0.50, 0.74	0.70*	0.57, 0.86	60	0.2	0.33*	0.26, 0.43	0.39*	0.30, 0.51
Obsessive-compulsive disorder	57	0.1	16	0	0.40*	0.23, 0.70	0.52*	0.26, 0.90	7	0	0.19*	0.09, 0.41	0.23*	0.11, 0.52
Phobia	163	0.3	32	0.1	0.28*	0.19, 0.41	0.30*	0.21, 0.45	20	0.1	0.19*	0.12, 0.30	0.21*	0.13, 0.34
Acute stress	180	0.3	159	0.4	1.27*	1.02, 1.57	1.49*	1.19, 1.86	99	0.3	0.84	0.66, 1.07	0.97	0.75, 1.25
Post-traumatic stress disorder	337	0.6	679	1.6	2.89*	2.54, 3.29	3.60*	3.13, 4.15	579	1.5	2.61*	2.29, 2.99	3.27*	2.82, 3.78
Anxiety, not otherwise specified	1,122	1.9	400	1	0.51*	0.46, 0.57	0.59*	0.56, 0.66	222	0.6	0.30*	0.26, 0.35	0.35*	0.30, 0.41
Somatoform/dissociative/factitious disorders	171	0.3	75	0.2	0.63*	0.48, 0.82	0.69*	0.52, 0.92	51	0.1	0.45*	0.33, 0.62	0.50*	0.36, 0.69
Other mental disorders	5,871	9.9	2,103	5.1	0.51*	0.49, 0.54	0.51*	0.50, 0.55	1,063	2.7	0.28*	0.26, 0.29	0.28*	0.26, 0.30

* $p < 0.05$ (statistically different from reference group).† A χ^2 test was performed.

‡ Reference group.

§ RR, relative risk; CI, confidence interval.

¶ Adjusted for sex and race (White vs. other).

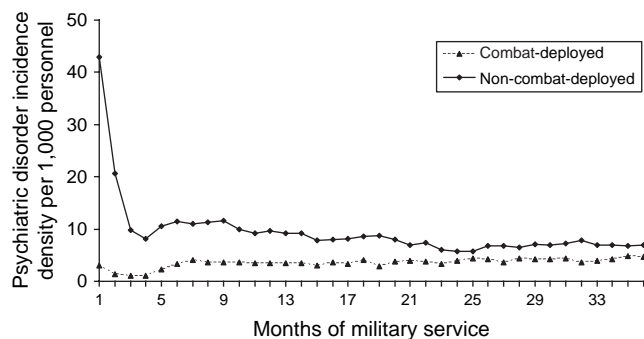


FIGURE 1. Incidence of first diagnosis of psychiatric disorder (inpatient and outpatient) per 1,000 personnel among Combat-deployed and non-combat-deployed US Marines, by months of military service, 2001–2005.

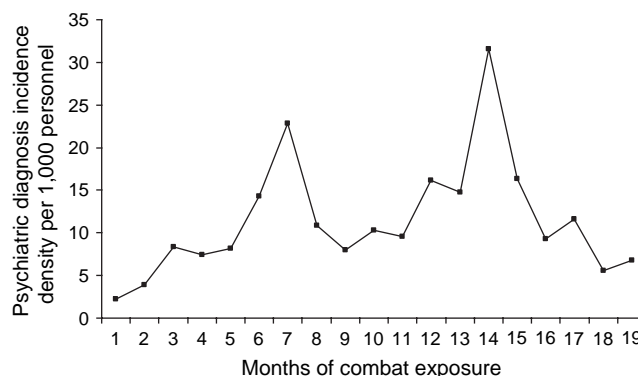


FIGURE 2. Incidence of first diagnosis of psychiatric disorder (inpatient and outpatient) per 1,000 personnel among combat-deployed US Marines, by months of combat exposure, 2001–2005. Persons diagnosed prior to combat deployment were excluded.

26.9 percent of the total combat-deployed cohort, and 31.6 percent of the subset with no predeployment diagnoses.

The non-combat-deployed cohort had a psychiatric diagnosis incidence rate of 42.9 cases per 1,000 personnel in the first month, which decreased markedly in month 2 (20.6 per 1,000) and month 3 (9.8 per 1,000) (figure 1). The rates stabilized for the rest of the follow-up period and ranged from 11.5 per 1,000 to 5.8 per 1,000. The combat-deployed Marines had only 3.1 cases per 1,000 personnel in the first month. The already low incidence density in this cohort decreased to 1.4 cases per 1,000 at month 2 and then to 1.0 cases per 1,000 at month 3. The incidence density for this cohort increased slightly to 4.2 per 1,000 personnel at month 7 and then ranged from 2.8 per 1,000 personnel to 4.8 per 1,000 personnel for the rest of the follow-up period, with no obvious pattern underlying the observed fluctuations. Although the incidence densities became closer in magnitude as time of service increased, the non-combat-deployed cohort had a higher density in every month of the observation period. In addition, a significant drop in incidence rates in the early follow-up period was observed only for the non-combat-deployed cohort.

Months of combat exposure

Once a person was diagnosed with a psychiatric disorder, he or she was removed from the incidence density denominator for all further combat months, even if the deployment continued or he or she was redeployed at a later date (figure 2). Psychiatric diagnosis densities peaked after 7 months of combat exposure and after 14 months of combat exposure (21.7 and 29.6 cases per 1,000 personnel, respectively), which corresponds with routine intervals for the return of deployed Marine units to their respective bases. By 19 months of combat exposure, rates fell to less than 10 per 1,000.

DISCUSSION

Our purpose in this study was to document the rate of diagnosed mental disorders in active-duty Marines deployed

during OIF/OEF and to compare this finding with rates of psychiatric diagnoses in historic samples and in contemporary military personnel not exposed to combat. Overall, Marine Corps personnel who had recently served in OIF/OEF had lower rates of diagnosed mental disorders than any other cohort in this study. Acute stress disorder and PTSD were the only diagnostic categories in which the combat-deployed cohort had significantly higher rates than the non-combat-deployed cohort. However, when deployed personnel with precombat mental health diagnoses were excluded from the sample, PTSD was the only psychiatric diagnosis for which the combat-deployed had higher rates. Interestingly, almost half of all Marine combatants with a psychiatric disorder were first diagnosed prior to their first combat deployment.

In this study, 11.8 percent of all contemporary deployed Marines had a diagnosed mental disorder. This rate is similar to other published information. The 2005 Department of Defense Survey of Health Related Behaviors Among Active Duty Military Personnel found that 12.7 percent of Marines had received some form of mental health counseling within the past 12 months and that 5.6 percent had received counseling specifically from a military mental health professional (11). Hoge et al. (15) reported that 6 percent of military personnel receive outpatient psychiatric treatment annually. In 2006, the National Research Council concluded that 30–35 percent of military personnel will experience psychological symptoms during their career and 10–15 percent will seek treatment (16), but their analysis did not consider the impact of combat exposure. Therefore, the military numbers reported here are not anomalous. By comparison, civilian studies, including the National Comorbidity Survey, have shown a lifetime prevalence of 40–50 percent for mental disorders (17).

Although other studies describing mental health problems in OIF/OEF veterans have recently been published (9, 10), comparison of cohorts is rare. With the inclusion of both historical and contemporary comparison cohorts, our findings here are put into a broader context. Consistent with the

“healthy warrior effect” (18), current combatants have fewer diagnosed psychiatric disorders relative to other cohorts of military personnel. A contributing factor is probably the early (predeployment) loss of many combatants with relatively serious psychological problems. As figure 1 shows, psychiatric disorders that are detected in Marines tend to be detected early, perhaps because the basic training environment may both cause high levels of stress that trigger serious adjustment problems in vulnerable persons and reveal dispositional traits that are incompatible with military service. If this is true, then basic training acts somewhat as a de facto psychological screening process wherein recruits must be resilient to succeed. As a result, deployed persons are deployed for the simple reason that they are healthy, and thus the OIF/OEF cohorts reflect the healthy warrior effect (18).

The healthy warrior concept, proposed by Haley (18), mirrors the “healthy worker” phenomenon documented in studies of occupational health (19, 20). Simply put, employed persons are inherently healthier than the general population, which also includes persons who are unemployable because of sickness or disability. Consequently, relatively low rates of disorders in workers (or warriors) cannot be taken as evidence that occupational exposures are innocuous. While the overall rates of psychiatric disorders in the combat-deployed group are low in comparison with the other cohorts, the strain of combat is beginning to appear in the form of an elevated incidence of PTSD, which is almost three times higher in the combat-deployed population than in the non-combat-deployed population. This is consistent with research by Hoge et al. (10), who found elevated rates of PTSD symptoms in a sample of military personnel deployed to OIF and/or OEF.

The combat-deployed cohort experienced peaks in psychiatric diagnoses after 7 months and 14 months of combat exposure (figure 2). These time periods coincide with periods when most Marines return home from deployments. Although a limitation of the medical data used in our study is that we had very limited access to diagnoses from war-zone medical sites, figure 2 illustrates that most Marines were completing a full deployment cycle before returning home. In other words, they were not experiencing symptoms severe enough while deployed to terminate their deployment. Furthermore, despite the fact that we did not have complete medical diagnoses from combat zones, the average Marine in our sample was stationed in a noncombat zone for 27.13 months, providing ample opportunity for using documented mental-health services that would have been recorded in our databases. In contrast, the average Marine in the concurrent non-combat-deployed cohort was stationed in a noncombat zone for 20.39 months.

The rate of diagnosed PTSD in our sample was lower than reported rates in military survey participants who meet the PTSD screening criteria for clinical evaluation. Specifically, the primary surveillance tool for behavioral issues in the military, the Department of Defense Survey of Health Related Behaviors Among Active Duty Military Personnel, found that of the more than 16,000 randomly selected service members who completed the most recent survey, 7.1 percent of OIF/OEF veterans reported enough PTSD symptoms to qualify for clinical referral (based on scoring rules

for the Post Traumatic Stress Disorder Checklist–Civilian, the most commonly used PTSD survey instrument in military research). The Millennium Cohort Study, the largest deployment health project in military history, found that of 48,447 Millennium Cohort service members who had been deployed to OIF/OEF and had combat exposure, 7.6 percent without prior PTSD reported enough PTSD symptoms to qualify for clinical referral (12). The PTSD results from these large-scale surveys are consistent with surveys of veterans from the first Persian Gulf war (6.2 percent of deployed personnel met PTSD screening criteria during their window of combat, according to Toomey et al. (4)), though higher than rates in British OIF veterans (21) and lower than some survey-based rates reported by the US Army (22).

Several factors help to explain why the PTSD diagnosis rate in our study (1.6 percent) was lower than published rates from PTSD screening questionnaires (a median of approximately 7–8 percent). Foremost may be the impact of false-positive results generated by surveys. In general, the positive predictive value of screening questionnaires is quite poor when disease prevalence is modest/rare, as in the example of PTSD (23–25). In the case of military PTSD surveys, the number of false-positive results may also be exacerbated by overreliance on symptoms rather than use of a more clinically meaningful profile that integrates other elements of the PTSD case definition, such as the occurrence of an identifiable traumatic event and posttrauma functional impairment.

An additional factor that may have contributed to the relatively low PTSD rates in our study is that 100 percent of our participants were active-duty personnel rather than Reservists, and the research literature indicates that active-duty personnel have relatively lower risks of combat stress-related disorders (26).

Our estimates did not include persons who were diagnosed in the war zone but subsequently received no additional treatment or services upon their return to domestic installations. Further work is planned to determine numbers of service members who receive psychiatric care only in the war zone. Other persons who were not included in any of our diagnosed samples included personnel who sought assistance from confidential mental health sources offered by the Department of Defense (such as Military OneSource (<http://www.militaryonesource.com>; Ceridian Corporation, Minneapolis, Minnesota)) and service members who used undocumented mental health resources, such as chaplains and counselors. In addition, the extent to which risk of a psychological disorder is increased due to combat exposure cannot be determined, because we do not know what the incidence rate would be in this specific sample had the war not occurred. The fact that a combat-exposed cohort has lower rates of disorder than a non-combat-deployed cohort does not prove a lack of association between combat and the development of psychiatric disorders, because the deployed and non-combat-deployed cohorts differ with regard to factors other than combat exposure.

Another limitation of this research is that many military personnel may be reluctant to seek assistance for mental health issues because of the effect it might have on their

careers. This reluctance probably spanned all of the cohorts we constructed, resulting in nondifferential misclassification bias, which should not have significantly affected the comparisons reported.

In conclusion, we found that rates of psychological disorders among combat-deployed Marines are lower than rates in any historical or contemporary non-combat-deployed sample, a finding that is compatible with the healthy warrior effect. Nevertheless, the combat-deployed group had significantly elevated rates of PTSD. Postdeployment screening for PTSD should therefore be rigorously promoted.

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REFERENCES

1. Kulka R, Schlenger W, Fairbank J, et al. Trauma and the Vietnam War generation: report of findings from the National Vietnam Veterans Readjustment Study. New York, NY: Brunner/Mazel, 1990.
2. Dohrenwend BP, Turner JB, Turse NA, et al. The psychological risks of Vietnam for U.S. veterans: a revisit with new data and methods. *Science* 2006;313:979–82.
3. Ursano N, Norwood AE. Emotional aftermath of the Persian Gulf War: veterans, families, communities, and nations. Washington, DC: American Psychiatric Press, 1996.
4. Toomey R, Kang HK, Karlinsky J, et al. Mental health of US Gulf War veterans 10 years after the war. *Br J Psychiatry* 2007; 190:385–93.
5. Kang HK, Natelson BH, Mahan CM, et al. Post-traumatic stress disorder and chronic fatigue syndrome-like illness among Gulf War veterans: a population-based survey of 30,000 veterans. *Am J Epidemiol* 2003;157:141–8.
6. Blanchard MS, Eisen SA, Alpern R, et al. Chronic multi-symptom illness complex in Gulf War I veterans 10 years later. *Am J Epidemiol* 2006;163:66–75.
7. Eisen SA, Kang HK, Murphy FM, et al. Gulf War veterans' health: medical evaluation of a U.S. cohort. *Ann Intern Med* 2005;142:881–90.
8. Hotopf M, David AS, Hull L, et al. Gulf war illness—better, worse, or just the same? A cohort study. *BMJ* 2003;327: 1370.
9. Hoge CW, Castro CA, Messer SC, et al. Combat duty in Iraq and Afghanistan, mental health problems, and barriers to care. *N Engl J Med* 2004;351:13–22.
10. Hoge CW, Auchterlonie MS, Milliken CS. Mental health problems, use of mental health services, and attrition from military service after returning from deployment to Iraq or Afghanistan. *JAMA* 2006;295:1023–32.
11. Bray RM, Hourani LL, Rae KL, et al. 2005 Department of Defense Survey of Health Related Behaviors Among Active Duty Military Personnel. Research Triangle Park, NC: Research Triangle Institute, 2006. (Report RTI/7841/106-FR).
12. Smith TC, Ryan MA, Wingard DL, et al. New onset and persistent symptoms of post-traumatic stress disorder self reported after deployment and combat exposures: prospective population based US military cohort study. *BMJ* 2008;336:366–71.
13. Operation Iraqi Freedom Mental Health Advisory Team. Operation Iraqi Freedom (OIF-II) Mental Health Advisory Team (MHAT-II) report. Washington, DC: Office of the US Army Surgeon General, 2005.
14. Rothman KJ. Modern epidemiology. Boston, MA: Little, Brown and Company, 1986.
15. Hoge CW, Lesikar SE, Guevara R, et al. Mental disorders among U.S. military personnel in the 1990's: association with high levels of health care utilization and early military attrition. *Am J Psychiatry* 2002;159:1576–83.
16. National Research Council. Mental health. In: Sackett PR, Mavor AS, eds. Assessing fitness for military enlistment: physical, medical and mental health standards. Washington, DC: National Academies Press, 2006:135–51.
17. Kessler RC, Berglund P, Demler O, et al. Lifetime prevalence and age-of-onset distributions of DSM-IV disorders in the National Comorbidity Survey Replication. *Arch Gen Psychiatry* 2005;62:593–602.
18. Haley RW. Point: bias from the “healthy-warrior effect” and unequal follow-up in three government studies of health effects of the Gulf War. *Am J Epidemiol* 1998;148:315–23.
19. Fox AJ, Collier PF. Low mortality rates in industrial cohort studies due to selection for work and survival in the industry. *Br J Prev Soc Med* 1976;30:225–30.
20. McMichael AJ. Standardized mortality ratios and the “healthy worker effect”: scratching beneath the surface. *J Occup Med* 1976;18:165–8.
21. Browne T, Hull L, Horn O, et al. Explanations for the increase in mental health problems in UK reserve forces who have served in Iraq. *Br J Psychiatry* 2007;190:484–9.
22. Hoge CW, Auchterlonie MS, Milliken CS. Mental health problems, use of mental health services, and attrition from military service after returning from deployment to Iraq or Afghanistan. *JAMA* 2006;295:1023–32.
23. Fletcher R, Fletcher S. Clinical epidemiology: the essentials. 4th ed. Philadelphia, PA: Lippincott Williams & Wilkins, 2005.
24. Grimes DA, Schulz KF. Uses and abuses of screening tests. *Lancet* 2002;359:881–4.
25. Brenner H, Gefeller O. Variation of sensitivity, specificity, likelihood ratios and predictive values with disease prevalence. *Stat Med* 1997;16:981–91.
26. Wolfe J, Erickson DJ, Sharkansky EJ, et al. Course and predictors of posttraumatic stress disorder among Gulf War veterans: a prospective analysis. *J Consult Clin Psychol* 1999;67: 520–8.

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14. ABSTRACT (maximum 200 words)

Research studies have identified heightened psychiatric problems in Operation Iraqi Freedom (OIF) and Operation Enduring Freedom (OEF) veterans. However, these studies have not compared psychiatric incidence rates across robust cohorts, nor have they documented psychiatric problems prior to combat exposure. The objectives of this study were to determine incidence rates of diagnosed mental disorders in a cohort of Marines deployed to combat in OIF or OEF and to compare these with mental disorder rates in four historical and contemporary military control groups. After excluding individuals who were deployed to a combat zone with a pre-existing psychiatric diagnosis, the cumulative rate of postcombat mental disorders was 6.39%. Posttraumatic stress disorder (PTSD) was the only condition with a higher rate in deployed versus nondeployed personnel (0.69% and 0.23%, respectively). Overall, Marine Corps personnel recently serving in OIF/OEF have lower rates of all mental disorders, with the exception of PTSD, than any other historical or contemporary cohort in this study. The findings suggest that psychiatric disorders are detected early in Marines, and the combat-deployed cohort illustrates the "healthy warrior effect."

15. SUBJECT TERMS
psychiatric disorders, Marines, Operation Iraqi Freedom, posttraumatic stress disorder, healthy warrior effect

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